

Council for Clean & Reliable Electricity (CCRE)

Introduction

- I'd like to talk to you tonight about the business I'm in, which is energy storage, and about the business that I hope all of us are in, which is **creating the cleanest, most efficient electricity grid possible**. By the end of the evening, I hope you'll see how closely they are tied together.
- I also want to tell you about how I got here, because as most of you know I didn't arrive to where I am today, as CEO of NRStor, by travelling in a straight line.
 - o I started in the coal business.
 - o I spent many happy years in the retail business.
- And while those are both significantly different from what I'm doing today, in those years I learned a great deal about customers, and about markets. And I think some of those things apply to where the energy business is today – or at least where it ought to be.

[Talk about Home Depot]

- When I decided it was time to leave Home Depot, my husband and I took some time to travel, to observe and to reflect about what to do next.
- My thinking turned to three broad areas that I think will draw an increasing amount of attention as we move forward. They are: **Water, Food and Energy**.
- Ultimately my interest in renewable energy and in conservation won out. And after some conversations with David Patterson at Northwater Capital, we decided to form NRStor, which would focus on the potential of energy storage to build cleaner, more efficient energy grids.

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Clean Energy Industry Potential

- A few years ago, the clean energy sector may have been regarded by many people as quaint but harmless, a permanent fringe player in the energy world. A few may even have thought of it as downright evil, displacing energy that could better be produced by cheaper, traditional resources.
- But I think it's safe to say that **thinking is now behind us. Even with the remarkable plunge in the price of oil and gas, interest and investment in clean energy technology is accelerating.** No doubt the prospect of carbon pricing has been a factor in spurring interest. But there can be no doubt that the interest is there. As evidence, I point to the increasing interest in this sector shown by Goldman Sachs. No one has ever accused the people at Goldman Sachs of being a band of naïve flower children. Their job is to put money to work. And they are putting plenty of money to work in clean energy.
- **In 2012, Goldman Sachs announced a clean energy financing investment target of \$40 billion.** The funds they planned to raise were to be directed to a spectrum of clean energy ventures, including solar, wind, biomass, geothermal, electric vehicles – and energy storage.
- Last year, Goldman Sachs revisited its target. The firm said the **\$40 billion goal was within reach, with \$37 billion of capital already mobilized.** It was time to recalibrate, it said. And **Goldman Sachs has now set an investment target of \$150 billion for clean energy and renewables, to be deployed by 2025.**
- That is real money talking. And you can bet that if Goldmans sees the opportunity, other firms are lining up as well.

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- The newly formed **Smart Prosperity Initiative**, here in Canada, estimates that **global demand for all types of clean energy goods and services will reach \$2 trillion in 2020.**
 - o You'll hear more about this initiative, of which I am a member, in the months to come as we roll out more ideas about bringing the economy and the environment into harmony, to the benefit of both.
- Clean energy is certainly an area where those of us who came together to launch NRStor see opportunity.

Importance of Energy Storage

- It may not be immediately obvious how energy storage plays a role in a clean energy system. After all, storage produces no energy, clean or otherwise. But while storage technology does not produce energy, what it does **is enable the creation of a cleaner, more efficient grid.** You could call it a catalyst that works in many ways, and on every scale, from the individual household to the grid level.
- Energy storage has certainly attracted the attention of the strategy unit at PwC, who see it both as a threat to utilities, if they ignore it -- and as a means for utilities to preserve their relevance, if they embrace it.
- PwC notes that the standard utility business model is being eroded by many factors:
 - o **A PwC survey of utility executives in 52 countries showed that nearly all expect a medium or high amount of market disruption by 2020 — and nearly half expect the biggest impact to come from energy storage.**

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- The cost of storage has been a barrier to its widespread adoption in the past, but that is rapidly changing.
- Here's how PwC puts it:
 - “If you are a strategist or leading executive for a utilities company, you should be wary of sitting on the sidelines while storage costs decline. Increasingly, your future will be linked to how well capacity and production are balanced with variable demand, intermittent supply resources, environmental concerns, and even the occasional unanticipated systemic interruption”.*
- If utilities aren't interested in storage technology, others are. PwC warns that that industrial giants like General Electric and NEC will move into the space. And so will brash, nimble start-ups.

NRStor's View of Energy Storage

- So let me talk for a few minutes about how we at NRStor see the role of storage, starting with the large scale and working down.

Utility-Scale Energy Storage

- At the macro level, NRStor is working with on several projects to serve grid operators.
- One is flywheel technology that enables system operators to integrate renewable energy smoothly onto the system.
 - The dominant sources of renewable power on most grids are wind and solar. Because both depend on weather, both present the problem of energy that ebbs and flows onto the grid.

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- That can result in issues maintaining system voltage and reliability, such as voltage swings.
 - An incandescent lightbulb may have a fair tolerance for this instability. But many large power users like hospitals with sensitive electronic equipment find that this plays havoc with their instruments.
 - It can dramatically impact daily operations, but it can also very substantially impact their bottom line – for the worse.
 - **They need a consistent supply of power, with clean, steady voltage.**
- NRStor has developed a flywheel facility near Minto, Ontario, that uses massive steel rotors to absorb short term surges of energy, which may occur when winds gust higher and turbines ramp up their output. That surplus is drawn off and used to power motors that spin the steel cylinders in an almost frictionless mechanism.
 - When the gusts ebb, the kinetic energy stored in the cylinders is used to generate power and re-inject it into the grid. The flywheels, developed by Temporal Power of Mississauga, can fine-tune the system, second by second, to keep voltage steady in the face of natural variability.
 - **Temporal is a shining example of Canadian innovation. They have developed the world's highest energy flywheels, locally, and are already exporting to other countries.**
 - Our 2-megawatt flywheel facility in Minto has been operating since 2014. We're very pleased with the way it operates, and so, we think, is the IESO.
 - That's an example of short-term storage on a grid scale. NRStor is also looking at longer term storage systems – capable of storing energy for hours or even for days – at the grid level.

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- The promise of long-term storage is in so-called **peak shaving**. Many systems have demand curves that balloon at certain times of day – for example in hot weather when air conditioning is needed, or in winter weather when cold and darkness set in together.
 - The traditional solution has been for grid operators to contract for peaking capacity – generators that run very seldom, but are needed to supply these short-term peaks in demand.
 - The peaking plants have to be paid even when they are idle, which makes the system inefficient. And they are mostly fuelled by natural gas, which emits carbon.
- A better solution is to make use of spare generating capacity in the system when demand is slack. And there are many periods during each week when there is plenty of idle capacity in the system. **We have a great opportunity to leverage the existing assets we already have to optimize system operation and effectiveness.**
- **We need to consider storage as an alternative to investing in traditional assets like poles and wires.** For example, instead of expanding a substation to meet peak load growth in a constrained residential area, can cost-effective energy storage solve this problem? We are looking at a number of projects across Canada just like this and we're certain it can.
- In Ontario, our nuclear plants operate for the most part 24/7, regardless of demand. Wind and solar generation often flows into the system in large quantity on weekends when demand is low. Excess supply is sometimes exported at prices below the cost of production; on occasion we have even paid our neighbours to take surplus power.

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- Long-term storage technology would allow us to capture this surplus power during a period of low demand – say a Sunday afternoon – and use it on Monday morning. Or perhaps to take the product of a Tuesday night wind storm and store the energy until Wednesday afternoon.
- **Using that surplus capacity on weekends and overnight to fill peak demand would decrease the need for peaking plants, and increase the efficiency of all other parts of the system.**

Energy Storage for Remote Communities

- But storage systems of considerable scale need not be connected to the main power grid. In fact, one of the big opportunities for storage technology is in serving communities that are not connected to the grid.
- **In Canada, this is the situation confronting hundreds of remote communities. Many of them are First Nations like Attawapiskat and Pikangikum.** Others are associated with mining operations.
- The most common means of producing electricity in these communities is with diesel generators. These generators are carbon-intensive. They require expensive diesel fuel to operate – fuel that must be hauled in from great distance in many cases.
- A far better solution, for at least part of their energy needs, would be to develop wind and solar generation and a robust energy storage system to supply their electricity.

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- We see a significant business opportunity in working with First Nations and other remote communities across Canada in **developing their own community micro-grids to reduce or eliminate their dependence on diesel generation.**
- Nor is this simply a Canadian opportunity. We are accustomed to having a strong grid almost everywhere. This is still not the case in much of the world. **There is a huge appetite for electricity as populations grow and economies develop.** These countries are rushing to build out their grids, but there is a huge opportunity for independent micro-grids to develop as well.
- I'll cite **India** as an example. **Its population, at 1.26 billion, is about 35 times Canada's.** Yet its installed generating capacity – which is nearing **300 gigawatts** according to the International Energy Agency -- is only about three times Canada's. **To put it another way, in Canada we use more than 15,000 kilowatt hours of electricity per person each year. In India, use per person is 744 kilowatt hours – or about one-twentieth that of Canada.**
- The Indian system is expanding at almost 7 per cent annually, and the room to grow is almost unlimited. **This is a huge opportunity for Canadian clean energy technology to become part of that growth story. And India is only one of dozens of countries with expanding economies, growing populations and a hunger for electricity.**
- Some Canadians are already acting. As some of you will know, **I am a member of the board of the MaRS Discovery District.** Ron Dizey, who heads the Advanced Energy Centre (AEC) at MaRS, has argued eloquently of the need of Canada and Canadian clean energy players to help feed the hunger for energy growth in Asia, Africa and Latin America.

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- Dizi argues that it is in Canada's interest to join in the massive build-out of electricity systems that's now under way – from remote micro-grids to mainstream systems. But he also argues that it's in our direct interest to make these systems as clean and efficient as possible, so they don't add to the planet's carbon burden.
- That's a challenge for Canadian business, and for our clean energy sector in particular. Canadian firms in the clean tech sector need to talk to people like Dizi – he recently returned from a trade mission to China – to find out how to become players in this huge opportunity. **And time is off the essence. The rush is on now, and those who wait will be left behind.**
- We're working very closely with the MaRS AEC on a variety of fronts to educate stakeholders and analyze the long-term value and impact of energy storage.

Residential Energy Storage

- But the opportunities for Canada's clean tech sector aren't all overseas, or on a large scale. Decentralized energy is playing a larger and larger role.
- At NRStor, we also think it's important to sell directly to consumers. We want to give them control of their own energy use and their own energy choices.
- That's why we, in partnership with Opus One Solutions, will soon be launching a new company that will bring the Tesla Powerwall to Canadian consumers. The Powerwall is an energy storage system that allows households much more control of their own energy use. It hangs on the wall and can be connected to rooftop solar panels, although in Canada those panels generally feed their energy straight into the grid.

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- The Powerwall offers homeowners backup power during outages to keep the lights on. It also allows customers to time-shift their electricity consumption. It gives consumers control of their energy use. It reduces peak demand, and therefore the need for expensive peaking plants. It boosts the over-all efficiency of the system by making use of spare capacity.
- We think it's a product and an idea that consumers will embrace.
- If it sounds as if I've returned to my retailing roots, I'm happy to say that I have indeed. **I like being directly involved with customers. They are the reason we're in business.**
- But the market for clean and green energy has lacked that direct customer connection. It has not been consumer led. Instead, if we look at the Ontario model, it was very much a top-down effort, driven by government policy and a very determined succession of energy ministers. It started with the promise to shut down the coal plants, and was boosted by the determination to implement the Green Energy Act.
- I am not being critical of this process. It took guts and vision for these leaders to push ahead with the green energy plan. Leadership was needed, and they stepped up. They created the condition that will allow for a successful transition to clean energy, and I applaud them for it.
- But government programs for clean energy are not the ultimate goal.
- **If we truly want to create a sustainable green energy economy, we have to involve the people who really matter in a market, and that is the customers.**

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- That's where I think we need to take the next step in a province like Ontario and a country like Canada. It's not that consumers are completely on the sidelines when it comes to clean energy. They're using all of the kilowatts from wind, solar and hydro generators being pumped into the grid. But it has been, so far, mostly a passive involvement.
- What about getting consumers actively involved in buying clean and green energy?
- Suppose I'm a consumer who wants to know that the electricity I use comes from clean sources. Suppose I'm interested in getting an electric vehicle. I'm happy not to be using gasoline. But I'm asking myself: Where does the electricity come from?
- What I'd like to do is call my local utility and say: "Sell me green power, please. " And right now, I can't.
- Yes, there are options. I can sign up with a retailer like Bullfrog Power, who have done a first-rate job of pioneering the idea of selling renewable power direct to consumers.
- But the alternatives are sparse. Most people deal directly with their LDC, and they are happy with that arrangement. Why don't LDCs offer their customers a choice of buying more renewable energy, right on their bill?
- **According to the IESO, in 2015 non-hydro renewables filled about 6 per cent of the demand on the Ontario grid.** So if you buy your electricity straight from the LDC, that's the amount of non-hydro renewable energy you're using. Why? Because that's what a group of central policy makers has decided.

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- What would happen if we left it up to consumers?
- Why don't consumers have an option of asking their LDCs to bump up the share of renewable energy they are using by 10, 20 or 50 per cent – with the LDC showing them the price difference? **It should be as easy to order up more renewable energy as ticking a box on a bill, or clicking an option on a website.**
- Of course, offering consumers a choice would place new obligations on both utilities and on the renewable energy industry. It would require marketing. It would require talking to consumers. It would require closing sales.
- But I think those are challenges that all those of us who support clean energy should embrace. **We need to let people choose clean energy. We need to create conditions where customers lead the market – where output is driven by demand.**
- So far, we've let public policy makers drive clean energy. I think it's time for those of us who believe in clean energy to take control and to take risks. It's time for us to be shaped by markets and by customer demand.

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Conclusion

- There is plenty of reason to be optimistic. Tonight I've spoken about my own company because it's what I know best. But in the storage segment of the clean energy world there are many other companies, some new, some established, with leading edge technology. Companies like Hydrostor, which uses deep water pressure to store electric energy in the form of compressed air. Or the many companies developing new battery technologies.
- I think it is getting more and more evident that **we can improve the economy and the environment at the same time. It's not just something we can do. It is something we need to do.** If we can see the billion and trillion-dollar opportunities sketched out by Goldman Sachs and Smart Prosperity, then so can others. They will not wait for Canadian businesses to catch up. They are already racing for the prize.
- **It's time for us to join the race.** Canada already has huge advantages in this field.